IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Timothy D. Evans et al.	: Art Unit:	1731
Serial No.:	09/700,475	: Examiner:	M. Steve Alvo
Filed:	January 11, 2001	:	
For:	PEROXIDE, OXYGEN, AND PEROXIDE/OXYGEN BRIGHTENING OF CHEMICAL AND MIXED WASTE PULPS	:	

DECLARATION OF RAYMOND C. FRANCIS, PH.D.

Assistant Commissioner for Patents
Washington, DC 20231

SIR:

I, Raymond C. Francis, Ph.D., declare that:

1. From May 1, 1987 to date, I have been employed by the State University of New York, College of Environmental Sciences and Forestry at Syracuse, New York. My present position is as a tenured research associate.

2. In August 1996, I entered into a research collaboration with National Silicates Ltd., in Toronto, Ontario, Canada. In the course of this research collaboration, periodic reports were exchanged between myself and researchers at National Silicates Ltd.

3. In February, 1997, I submitted an interim Report on the progress of the Graduate Research Fellowship in Silicate Chemistry to National Silicates Ltd.

4. The Interim Report I submitted to National Silicates Ltd. in February 1997 was an internal communication between research collaborators that was not intended to be publicly disclosed in any manner.

5. To my knowledge, the Interim Report was not published, distributed, or disclosed outside of the research collaboration of National Silicates Ltd. and the State University of New York, Syracuse. The first known publication of the subject matter of the report, to the best of my knowledge, was January 1998.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above-identified application or any patent issued thereon.

Dated: 9/20/2002

Raymond C. Francis
DECLARANT

Table 1
Effect of Magnesium Sulfate Application on P/O Bleaching of First ECF Kraft Pulp

	Sample 1	Sample 2	Sample 3	Sample 4
Silicate, % on pulp	4.0	4.0	4.0	4.0
NaOH, % on pulp	2.3	2.3	2.3	2.3
H_2O_2, % on pulp	1.5	1.5	1.5	1.5
$MgSO_4 \cdot 7H_2O$ % on pulp	0.0	0.25	0.5	0.75
SiO_2, % on pulp	1.148	1.148	1.148	1.148
Mg, % on pulp	0.0	0.025	0.050	0.075
Mg:SiO_2 mass ratio	0	1:46	1:23	1:15
End pH	10.2	10.5	11.0	11.2
Brightness, %	79.8	84.0	84.2	85.3
Yield, %	97.2	97.7	98.1	98.2
Viscosity, cp	8.8	11.4	13.5	14.1
Residual H_2O_2, %				
30 Minutes	2	25	35	33
60 Minutes	0	15	22	30
120 Minutes	0	2	7	10

Table 1 shows that an $MgSO_4 \cdot 7H_2O$ charge of 0.25% on pulp (250 ppm Mg on pulp) increased brightness significantly, namely from 79.8% to 84.0%. Also, the brightness increased further when 0.50 and 0.75% $MgSO_4$ $7H_2O$ was used. The interesting and totally novel result from Table 1 is the increase in pulp yield caused by the addition of magnesium sulfate. Kraft pulps can be dissolved in a solution of cupriethylenedianine, and the viscosity of the solution is an indicator of the degree of polymerization of the cellulose in the pulp. It can be seen that a higher charge of magnesium sulfate also resulted in higher viscosities (less depolymerization of cellulose during H_2O_2 brightening). However, the lowest viscosity (no $MgSO_4 \cdot 7H_2O$) corresponds to an average DP of 815. It is unlikely that cellulose molecules of such high DP would solubilize. Therefore, it appears that hemicelluloses were being dissolved. Most likely, the free radicals from H_2O_2 decomposition were causing depolymerization of the hemicelluloses to a degree that resulted in their solubilization.

ATOMIC WEIGHTS

(Alphabetical Order)

Element	Symbol	Atomic number	Atomic weight	Element	Symbol	Atomic number	Atomic weight
Actinium	Ac	89	227.0278*	Neodymium	Nd	60	144.24
Aluminum	Al	13	26.981539	Neon	Ne	10	20.1797
Americium	Am	95	243.0614*	Neptunium	Np	93	237.0482*
Antimony	Sb	51	121.75	Nickel	Ni	28	58.69
Argon	Ar	18	39.948	Niobium	Nb	41	92.90638
Arsenic	As	33	74.92159	Nitrogen	N	7	14.00674
Astatine	At	85	209.9871*	Nobelium	No	102	259.1009*
Barium	Ba	56	137.327	Osmium	Os	76	190.2
Berkelium	Bk	97	247.0703*	Oxygen	O	8	15.9994
Beryllium	Be	4	9.012182	Palladium	Pd	46	106.42
Bismuth	Bi	83	208.98037	Phosphorus	P	15	30.973762
Boron	B	5	10.811	Platinum	Pt	78	195.08
Bromine	Br	35	79.904	Plutonium	Pu	94	244.0642*
Cadmium	Cd	48	112.411	Polonium	Po	84	208.9824*
Calcium	Ca	20	40.078	Potassium	K	19	39.0983
Californium	Cf	98	251.0796*	Praseodymium	Pr	59	140.90765
Carbon	C	6	12.011	Promethium	Pm	61	144.9127*
Cerium	Ce	58	140.115	Protactinium	Pa	91	231.0359*
Cesium	Cs	55	132.90543	Radium	Ra	88	226.0254*
Chlorine	Cl	17	35.4527	Radon	Rn	86	222.0176*
Chromium	Cr	24	51.9961	Rhenium	Re	75	186.207
Cobalt	Co	27	58.93320	Rhodium	Rh	45	102.90550
Copper	Cu	29	63.546	Rubidium	Rb	37	85.4678
Curium	Cm	96	247.0703*	Ruthenium	Ru	44	101.07
Dysprosium	Dy	66	162.50	Samarium	Sm	62	150.36
Einsteinium	Es	99	252.083*	Scandium	Sc	21	44.955910
Erbium	Er	68	167.26	Selenium	Se	34	78.96
Europium	Eu	63	151.965	Silicon	Si	14	28.0855
Fermium	Fm	100	257.0951*	Silver	Ag	47	107.8682
Fluorine	F	9	18.9984032	Sodium	Na	11	22.989768
Francium	Fr	87	223.0197*	Strontium	Sr	38	87.62
Gadolinium	Gd	64	157.25	Sulfur	S	16	32.066
Gallium	Ga	31	69.723	Tantalum	Ta	73	180.9479
Germanium	Ge	32	72.61	Technetium	Tc	43	97.9072*
Gold	Au	79	196.96654	Tellurium	Te	52	127.60
Hafnium	Hf	72	178.49	Terbium	Tb	65	158.92534
Helium	He	2	4.002602	Thallium	Tl	81	204.3833
Holmium	Ho	67	164.93032	Thorium	Th	90	232.0381
Hydrogen	H	1	1.00794	Thulium	Tm	69	168.93421
Indium	In	49	114.82	Tin	Sn	50	118.710
Iodine	I	53	126.90447	Titanium	Ti	22	47.88
Iridium	Ir	77	192.22	Tungsten	W	74	183.85
Iron	Fe	26	55.847	Unnilquadium	Unq	104	261.11*
Krypton	Kr	36	83.80	Unnilpentium	Unp	105	262.114*
Lanthanum	La	57	138.9055	Unnilhexium	Unh	106	263.118*
Lawrencium	Lr	103	262.11*	Unnilseptium	Uns	107	262.12*
Lead	Pb	82	207.2	Uranium	U	92	238.0289
Lithium	Li	3	6.941	Vanadium	V	23	50.9415
Lutetium	Lu	71	174.967	Xenon	Xe	54	131.29
Magnesium	Mg	12	24.3050	Ytterbium	Yb	70	173.04
Manganese	Mn	25	54.93805	Yttrium	Y	39	88.90585
Mendelevium	Md	101	258.10*	Zinc	Zn	30	65.39
Mercury	Hg	80	200.59	Zirconium	Zr	40	91.224
Molybdenum	Mo	42	95.94				

Based on 1987 IUPAC Table of Standard Atomic Weights of the Elements.
* Relative atomic mass of the isotope of that element with the longest known half-life.

Atomic number	Elem
1	Hydro
2	Helium
3	Lithiur
4	Berylli
5	Boron
6	Carbor
7	Nitrog
8	Oxyge
9	Fluorir
10	Neon
11	Sodiun
12	Magne
13	Alumir
14	Silicon
15	Phosph
16	Sulfur
17	Chlorir
18	Argon
19	Potassi
20	Calciur
21	Scandi
22	Titaniu
23	Vanadi
24	Chrom
25	Manga
26	Iron
27	Cobalt
28	Nickel
29	Coppe
30	Zinc
31	Galliur
32	Germa
33	Arseni
34	Seleni
35	Bromi
36	Krypto
37	Rubidi
38	Stronti
39	Yttriur
40	Zircon
41	Niobiu
42	Molyb
43	Techn
44	Ruther
45	Rhodiu
46	Palladi
47	Silver
48	Cadmi
49	Indium
50	Tin
51	Antim
52	Telluri
53	Iodine
54	Xenon

Based on 1987 IUP
* Relative atomic m